Appendix E

Water Quality

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Prepared for:

U.S. Department of Transportation, Federal Highway Administration
New York State Department of Transportation

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List of Abbreviations and Acronyms

BSA	Buffalo Sewer Authority
CFR	Code of Federal Regulations
CWA	Clean Water Act
E & E	Ecology and Environment, Inc.
EPA	U.S. Environmental Protection Agency
EPC	Environmental Performance Commitments
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
NEPA	National Environmental Policy Act
NYSDOT	New York State Department of Transportation
NPDES	National Pollutant Discharge Elimination System
NURP	Nationwide Urban Runoff Program
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSTA	New York State Thruway Authority
PAHs	polycyclic aromatic hydrocarbons
SEQRA	New York State Environmental Quality Review Act
SPDES	State Pollutant Discharge Elimination System
SWPPP	Storm Water Pollution Prevention Plan
WQv	Water Quality Treatment volume
TMDL	Total Maximum Daily Load
USACE	U.S. Army Corps of Engineers
USDOT	U.S. Department of Transportation
WWTP	Wastewater Treatment Plant

1 Introduction

The Federal Highway Administration (FHWA), in cooperation with the New York State Department of Transportation (NYSDOT), has prepared this Final Environmental Impact Statement (FEIS) in accordance with the National Environmental Policy Act (NEPA) for the New York Gateway Connections Improvement Project to the U.S. Peace Bridge Plaza (Project). The Project is located in the city of Buffalo, Erie County, New York. The Project was developed to address concerns centered on the use of local streets by cross-border traffic as it enters/exits the existing U.S. Border Port of Entry/Peace Bridge Plaza (Plaza). For this Project, the FHWA and NYSDOT are the NEPA joint lead agencies, and NYSDOT is the New York State Environmental Quality Review Act (SEQRA) lead agency.

The FEIS was prepared in accordance with the NYSDOT Project Development Manual, 17 NYCRR (New York Codes, Rules and Regulations) Part 15, and 23 CFR (Code of Federal Regulations) 771. The need, purpose, and objectives of the Project and the alternatives being considered are briefly described below. More detailed discussions concerning the Project, the environmental considerations, and options considered are provided in Chapters 1, 2, 3, 4, and 6 of the FEIS.

This appendix presents information on surface water and groundwater in the vicinity of the Project. This Appendix identifies potential sources of surface water and groundwater pollution, erosion, sedimentation, and storm water runoff effects that may result from construction, use, and maintenance of the Project.

1.1 Where is the Project Located?

The Project is located in the West Side neighborhood of the city of Buffalo, Erie County, New York. The Project area is adjacent to Front Park, which was designed by Frederick Law Olmsted as part of a citywide park and parkway system that opened in 1868; the Project also includes a small portion of the park (the existing Baird Drive). Major roadways in the Project area include the Niagara Thruway (Interstate 190, or I-190), Porter Avenue, Baird Drive, Busti Avenue, and the I-190 ramp connections to and from the Plaza.

1.2 Need, Purpose, and Objectives

The primary need for the Project is to address the limited direct access between the Plaza and I-190. Existing direct access is limited and requires regional and international traffic to use the local street system. This limited direct access increases commercial traffic on the local streets, which were originally designed to only meet the needs of local traffic. An additional need was identified to address the structurally deficient Porter Avenue Bridge over I-190.

The purpose of this Project is to reduce the use of the local streets by interstate traffic (autos and trucks) and provide access to and from the existing Plaza at its current location.

The following objectives have been established to support the Project's purpose and need.

- Provide direct access from the Plaza to northbound I-190,
- Redirect through traffic from Front Park,
- Remove Baird Drive, and
- Replace the Porter Avenue Bridge over I-190 and CSX Railroad.

1.3 Project Alternatives

Based on the Project's need, purpose, and objectives, the following paragraphs briefly describe the alternatives that have been developed for study within this FEIS.

- ***No-Build Alternative.*** The No-Build Alternative assumes no improvements in the Project area other than those planned by others or implemented as part of routine maintenance. Although the No-Build Alternative does not meet the Project's purpose and need, NEPA requires that it be evaluated in the EIS. The No-Build Alternative also serves as the baseline condition against which the potential benefits and effects of the Build Alternative are evaluated.
- ***Build Alternative.*** The Build Alternative would construct a new ramp (Ramp D), providing direct access from the Plaza to northbound I-190. It would also construct a new ramp (Ramp PN) from Porter Avenue to the existing I-190 northbound exit-ramp (Ramp N/Ramp A) to the Plaza. The combination of these new ramps would allow the removal of Baird Drive from Front Park and conversion of the existing 1.8 acres of roadbed and sidewalk into additional green space. The removal of Baird Drive would permit 4.5 acres of green space located between Busti Avenue and Baird Drive to be reconnected to the greater park area. This alternative would require modifications to the Massachusetts Pumping Station access road, the Shoreline Trail bicycle/pedestrian facility along the waterfront, and four existing exit/entry ramps in the vicinity of the Plaza, as well as new signing in the vicinity of and within the Plaza to better direct vehicles to the appropriate ramps and routes.

Two modifications to Porter Avenue were studied. Modifications included either a roundabout or signalized intersection at 4th Street and the location of Ramps PN and Ramp N along with the removal and replacement of the bridge over I-190 to optimize the traffic flow to the Plaza from I-190 northbound. Construction of the new bridge would allow for the construction of a new shared-use path along Porter Avenue connecting Front Park to LaSalle Park and the Niagara River waterfront.

The Shoreline Trail (Riverwalk) crossing over the CSX railroad would be relocated along a new alignment north of its existing location to accommodate construction of the new Ramp D. A new structure would be constructed over I-190 and the CSX railroad, and the realigned Shoreline Trail would then turn south along the Black Rock Canal. The new trail segment would extend directly along the waterfront before connecting to the existing Shoreline Trail south of its existing underpass beneath I-190.

2 Water Resources

2.1 Surface Water

Due to intensive urban development, major surface water resources in the immediate vicinity of the Project area are limited to the Niagara River and the Black Rock Canal. Additional perennial and intermittent surface water drainages are located on the west side of Buffalo, but none would be affected by this Project.

2.2 Wetlands

There are no mapped wetlands within 1.5 miles of the Project Area.

2.3 Groundwater

Groundwater in the immediate vicinity of the Project, although near the surface, is not used as a potable water source. The Project area is not located over a sole-source aquifer, as designated by the U.S. Environmental Protection Agency (EPA), or a state-designated primary or principal aquifer. Groundwater elevations within the Project area are approximately 7.5 to 37 feet below ground surface, and the water table fluctuates seasonally. The impervious nature of the existing ramps and planned changes to the ramps leading to and from the Plaza and associated surface water collection and conveyance systems prevent surface contamination from reaching the groundwater. Therefore, groundwater quality would not be affected pacted by this Project.

3 Pollutants

Pollutants from vehicles, maintenance, and deposition of air emissions accumulate on the road surfaces. These pollutants are primarily moved from the road surfaces to surface waters by rainfall runoff and the melting of snow and ice. Although these contaminants have the potential to adversely affect the quality of surface water in the vicinity of the Project, these effects are minimized by the design of the closed storm water collection and conveyance systems. These collection systems incorporate a combination of grit, sediment, and oil separator devices to control the initial runoff, or water quality treatment volume (WQv), thus preventing the potentially most polluted runoff from discharging directly into nearby surface waters. State Pollutant Discharge Elimination System (SPDES) general permits (GP-0-10-001, etc.) require the completion and implementation of a Storm Water Pollution Prevention Plan (SWPPP). As part of the SWPPP, the project design shall be develop and implement storm water management practices, including WQv.

Most of the storm water flows over the Project area roadways via sheet flow and is collected in closed surface drainage collection and conveyance system prior to being discharged. The storm water collection and conveyance system carries the WQv and low flows to the Buffalo Sewer Authority (BSA) Bird Island Wastewater Treatment Plant (WWTP), where it is processed and then discharged to the Black Rock Canal. Heavy flows that exceed the capacity of the first-flush system are discharged directly to the Black Rock Canal.

3.1 Use of De-Icing Chemicals

Sodium chloride and calcium chloride salts (de-icers) and sand are used on local roadways and highways to maintain safe travel conditions during winter months. These de-icing materials are collected in the existing storm water system on city streets and along I-190. The flush of storm water collected in the storm water system from local city streets is collected and conveyed to either to the Bird Island WWTP for treatment or discharge directly into the Black Rock Canal. Storm water runoff treated at the Bird Island WWTP does not affect local surface water. The limited amount of storm water discharged directly to the Black Rock Canal has a minimal potential to effect local surface water. A Toler Method Analysis was conducted to determine whether any effect on surface water would result.

3.2 Metals Pollutants

Copper, lead, and zinc are the most dominant toxic pollutants contributed by highway storm water runoff. These pollutants are contaminants within materials deposited on the roadway as a result of tire and brake wear, vehicle exhaust, and mud and dirt that falls from vehicles. These pollutants are carried into adjacent surface water bodies by storm water runoff and wind. Currently, the existing storm water collection and conveyance system contains much of the storm water runoff and conveys it to the Bird Island WWTP, where it is processed before being discharged to the Black Rock Canal. Flows that exceed the capacity of the first-flush system or are collected from those portions of the storm water collection system that are not connected to Bird Island are discharged directly into the Black Rock Canal.

4 Erosion and Sedimentation

Erosion and sedimentation effects associated with transportation infrastructure are caused primarily during construction, when soils are stripped of their impervious cover and vegetation. The use and maintenance of transportation infrastructure also contributes to sedimentation: materials used to sand road surfaces; materials from tire, brake, and pavement wear; particulates from vehicle exhaust; and mud and dirt that has fallen from vehicles are transported by runoff. These pollutants are prevented from entering adjacent water bodies by the collection and conveyance system mentioned above.

Any affects resulting from erosion and sedimentation during construction would be temporary, minor, and limited to the period of construction activities. A site-specific SWPPP is required and would be prepared during final design.

5 Effects Analysis

To estimate the affects the Project may have on surface water quality, the current conditions and the modeled conditions under the Build Alternative were compared.

5.1 Use of De-Icing Chemicals

The current storm water collection, conveyance, and discharge system would be maintained under the No Build Alternative, and no additional effect on surface water quality would result.

The Build Alternative would result in a reduction in the overall amount of impermeable surface area within the Project area, with the newly permeable surface area being returned to green space within the confines of Front Park (see Attachment 1). Using the Toler Method (NYSDOT 1995), the estimated effect under the Build Alternative would not change and would be less than 0.02% of the normal chloride concentration of the Niagara River/Black Rock Canal. Thus, the Build Alternative would have no effect on surface water quality.

5.2 Metals Pollutants

The use and maintenance of the roadways and access ramps leading to and from the Plaza can contribute to the possible degradation of the quality of water resources adjacent to the Project area. Materials used to clear road surfaces; materials worn from tires, brakes, and pavement; particulates from vehicle exhaust; and mud and dirt that falls from vehicles can be transported by surface water runoff and wind into the adjacent surface water bodies. The existing surface water runoff collection and conveyance system prevents effects on surface waters in the vicinity of the Project by insuring that much of the storm water runoff is treated before being discharged to nearby surface waters.

The concentrations of copper, lead, and zinc in the waters of the Niagara River/Black Rock Canal that would result from the Build Alternative were estimated using *Pollutant Loadings and Impacts from Highway Storm Water Runoff* (USDOT 1990) (see Attachment 2).

The concentrations of copper, lead, and zinc were examined because these metals have been shown to be the most dominant toxic pollutants contributed by highway storm water runoff (USDOT 1990). The following assumptions and conditions were applied in order to complete this analysis:

- Pollution sources include the impervious surface within the Project Area. This number was generated using the same values used as in the deicing analysis.
- Rainfall, stream flow, and hardness data were taken from USDOT 1990.
- Urban traffic conditions were assumed to be greater than 30,000 vehicles per day.

The method used in USDOT 1990 assumes that an affect may occur if the ratio of the predicted once-in-three-year stream concentration of a metal to its U.S. Environmental Protection Agency (EPA) acute criterion is 1.0 or greater. The acute criteria were developed by the EPA to protect freshwater aquatic life. The acute criteria concentrations increase with total water hardness (measured as milligrams per liter (mg/L) of calcium carbonate ($CaCO_3$) of the receiving water. The water hardness in the area studied is expected to range from 120 to 180 mg/L $CaCO_3$; therefore, an assumed average water hardness of 150 mg/L $CaCO_3$ was used. The once-in-three-year stream pollutant concentrations were compared with the corresponding acute criteria for each heavy metal. The acute criteria for copper, lead, and zinc are presented in Table 5-1.

Table 5-1 Summary of Once-in-Three-Year Stream Pollutant Concentrations (mg/L)

		Copper		Lead		Zinc	
		EPA NURP Criteria		EPA NURP Criteria		EPA NURP Criteria	
		Acute:	0.026	Acute:	0.137	Acute:	0.450
		Threshold:	0.060	Threshold:	0.600	Threshold:	0.945
		Once-in-Three-Year Stream Pollutant Concentration					
Alternative	Watershed	Existing	Proposed	Existing	Proposed	Existing	Proposed
No Build	Existing	0.0001	N/A	0.0004	N/A	0.0013	N/A
Preferred	U.S. side	N/A	0.0001	N/A	0.0006	N/A	0.0020

Criteria Source: FHWA-RD-88-006, April 1990, Table 4.
Water hardness = 150 mg/L $CaCO_3$.

Key:
N/A = Not Applicable
NURP = Nationwide Urban Runoff Program.

The acute criteria were conservatively developed using 96-hour test exposures of the pollutants to the most sensitive aquatic species but are specified as a maximum 1-hour average with a 3-year return period. The criteria are based on a continuous exposure concept, although actual exposures of aquatic life to contaminants in storm water runoff are intermittent and short in duration. Therefore, the EPA's Nationwide Urban Runoff Program (NURP) developed estimates of approximate concentrations that would cause adverse effects for short-duration, intermittent exposures. These concentrations are referred to as threshold effect levels (USDOT 1990).

This analysis confirmed that the current concentrations of copper, lead, and zinc from the existing roadways and ramps are well within acceptable levels and have little to no effect on the environment. Predicted future concentrations of copper, lead, and zinc for the No Build Alternative and the Build Alternative would remain well within acceptable levels and, thus, would have no affect on the aquatic environment.

6 Mitigation

6.1 Surface Water

Mitigation of potential affects on surface water involves the installation and maintenance of an adequately sized and designed storm water collection and conveyance system to restrict the potential for surface runoff from the new ramps and additional impervious roadway along Porter Avenue to enter area waterways. The storm water collection and conveyance system would effectively eliminate the potential for most pollutants to be discharged directly into either the Black Rock Canal or the Niagara River.

6.2 Groundwater

No mitigation is required as this Project would not affect groundwater.

6.3 Erosion and Sediment Control

The Build Alternative would require the removal of approximately 1.8 acres of impervious pavement and a limited amount of grass area between Baird Drive and the adjacent sidewalk. Removal of the pavement and construction of the new entrance into Front Park will result in these areas being exposed to wind and water for a limited period of time. A site-specific SWPPP would be implemented to minimize erosion and protect the quality and quantity of downstream surface waters so that they are not significantly altered from existing conditions during construction.

The project-specific SWPPP design and mitigation measures would be completed during final design in accordance with the NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-10-001), and the requirements of NYSDOT's Standard Specifications for Soil Erosion and Sediment Control (NYSDOT 2009). The *New York State Standards and Specifications for Erosion and Sediment Control* (NYSDEC 2005) and various other texts on storm water and water quality would be used to evaluate appropriate erosion and sedimentation mitigation measures. The critical elements of an SWPPP are described in Section 7 of this appendix.

The use of proper design standards, inspections during construction, and regular cleaning and maintenance of erosion and sediment control features would minimize the potential for erosion and sedimentation during and after construction.

6.4 Environmental Performance Commitments

The use of best management practices and the enforcement of Environmental Performance Commitments (EPCs) included within the construction contracts would ensure that construction activities adjacent to the Black Rock Canal would not affect water quality and would not lead to any subsequent indirect effect on aquatic habitats downstream of the Project area. Any potential effects to water quality would be short-term, minor, and limited to the area immediately adjacent to the construction zone.

7 Critical Elements for an Stormwater Pollution Prevention Plan

During the construction and post-construction periods, erosion and sedimentation must be controlled to prevent adverse effects on the Project area's topography, water quality and quantity, storm drainage systems/pathways, and existing or potential vegetation. Erosion can occur when open excavations, disturbed areas, and soil stockpiles are exposed to wind, the vertical force of rain, and storm water runoff. Sedimentation occurs when water velocities decrease and suspended particles settle out, collecting in storm sewers and drainage ways, including Waters of the United States.

Sensitive on-site and adjacent off-site areas that may be affected by the Project include surface water bodies, public recreation areas, and residential and commercial properties. An SWPPP would be prepared during final design that addresses each stage of the Project, from initial construction mobilization to post-construction. Erosion control would be critical for soil stabilization, control of runoff, and prevention of sedimentation. Storm water management and minimizing the effects of wind are essential to controlling erosion and sedimentation. Methods and practices used to manage storm water runoff and wind exposure within the Project Area would vary from temporary to permanent, depending on site-specific characteristics.

7.1 Storm Water Management

The SWPPP would detail the site-specific methods that would be implemented to control or reduce the rate of storm water runoff, reduce potential erosion of exposed soil, and minimize potential flooding. Engineering controls such as diversion ditches, vegetative swales, and retention/detention ponds/systems would be designed into the Project.

7.2 Wind Management

Wind is an almost constant condition that must be considered due to the Project's location on the leeward edge of Lake Erie. Dust arising from construction sites can cause off-site nuisance, damage, and traffic safety problems. The SWPPP would identify and define controls to prevent or reduce wind erosion and dust during and after construction activities. Soil stockpiles would need to be protected from the wind. Construction activities should be scheduled to minimize the extent of disturbed areas at any one time, thus avoiding the exposure of large areas of open soil to the adverse effects of wind. Vegetative cover, mulch, spray adhesives, water sprinkling, and wind barriers also may be employed.

8 References

New York State Department of Environmental Conservation (NYSDEC), 2005, *New York State Standards and Specifications for Erosion and Sediment Control*, Albany, New York.

New York State Department of Transportation (NYSDOT), 1995, *Environmental Procedures Manual*, Chapter 4.5, Water Quality Standards and Assessment Methodologies.

__________, 2009, *Standard Specifications*, Soil Erosion and Sediment Control, Albany, New York.

United States Department of Transportation (USDOT), 1990, *Pollutant Loadings and Impacts from Highway Stormwater Runoff, Federal Highway Administration*, Publication No. FHWA-RD-88-006, April 1990.

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A Toler Method Analysis

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Attachment A

Toler Method Analysis

Toler Method Analysis Calculations & Discussion

Evaluation of Impacts to Water Quality

The addition of Ramp D, the removal of Baird Drive, the change to the vehicular entrance to Front Park and the rebuilding of the Porter Avenue Bridge by the NY Gateway Connections Improvement Project to the U.S. Peace Bridge Plaza (Project) results in an overall reduction in the existing impervious pavement area. It is these impervious pavement areas where de-icing chemicals are applied seasonally that are of concern. Soil and groundwater will not be affected by this Project due to presence of an established storm water runoff collection and containment system that collect stormwater from the current paved areas and discharges the runoff to the Buffalo Sewer Authority's Bird Island Waste Water Treatment System or the Black Rock Canal. The new paved area will be designed to collect and transport storm water to the existing system and eliminate almost all runoff; thus minimizing the potential for impacts to nearby surface waterbodies (i.e., Black Rock Canal and ultimately, the Niagara River).

Approximately 12,048 ft^2 less of impervious area will exist as a result of this proposed Project. **Table 1** identifies the proposed change in impervious pavement area within the Project Area.

Table 1: Proposed Changes to the Impervious Pavement Area

Area of Change/Description of Action	Pavement (ft^2)		
	Existing	Proposed	Change
Front Park			
Removal of Baird Drive	58,980	0	(58,980)
Removal of Existing Vehicular Entrance	9,674	0	(9,674)
New Vehicular Entrance	0	2,748	2,748
Net Change in Pavement Area	68,654	2,748	(65,906)
Ramps			
Construction of Ramp D	0	43,535	43,535
Construction of Ramp PN	0	11,029	11,029
Change in Ramp A Configuration	55,631	73,719	18,088
Change in Ramps N and C Configuration	82,255	62,909	(19,346)
Net Change in Pavement Area	137,886	191,192	53,306
Porter Avenue			
Rebuild Porter Avenue Bridge	12,273	11,990	(283)
Removal of Park vehicular entrance	8,755	6,301	(2,454)
Addition of Roundabout	38,981	42,270	3,289
Net Change in Pavement Area	60,009	60,561	552
Impervious Pavement Totals	266,549	254,501	(12,048)

The reduction in impervious area is expected to result in a decrease of five tons of salt used annually.

Methodology

The Toler Formula (NYSDOT, IPDG No.15) was used to determine the annual average concentration of chloride in the drainage basin. A chloride concentration above 250mg/L in the storm water that is being discharged into the Black Rock Canal is considered to have a negative impact on the ecological conditions of the receiving waters.

The Toler Formula is as follows:

$$\frac{T \times M}{I \times A} \times K = C$$

Where:

T = Tons of salt per lane mile
M = Number of lane miles
I = Inches of runoff (40% of annual inches of rain)
A = Drainage area in square miles
K = 8.37 for chloride
C = Annual average concentration in mg/L
A shock factor of 2 was used to determine shock load concentration.

The amount of de-icing salt applied to local interstate roadways (tons of salt used per lane mile) was obtained from the New York State Thruway Authority Maintenance Division salt use records from 1978 to present. The average salt usage for the I-190 was 36.0 tons per lane mile.

The number of lane miles was determined by dividing the area (ft^2) of impervious pavement by 12 (estimated average lane width) and then divided by 5280 feet/mile.

Lake Erie's current chlorine concentration is 15 to 20 mg/L (see EPA graph below). Lake Erie flows directly into the Niagara River and the Black Rock Canal and water quality is assumed to be identical in this region.

Results

The Toler Method Analysis was performed for the Project and indicates that chloride concentrations from de-icing chemicals would not alter or otherwise affect the concentration of the waters of the Black Rock Canal or the Niagara River. Anticipated chloride concentration is 0.0001 mg/L for the proposed condition and shock load concentration is 0.0002 mg/L. This is below the toxicity criterion (250 mg/L) set by the New York State Department of Transportation.

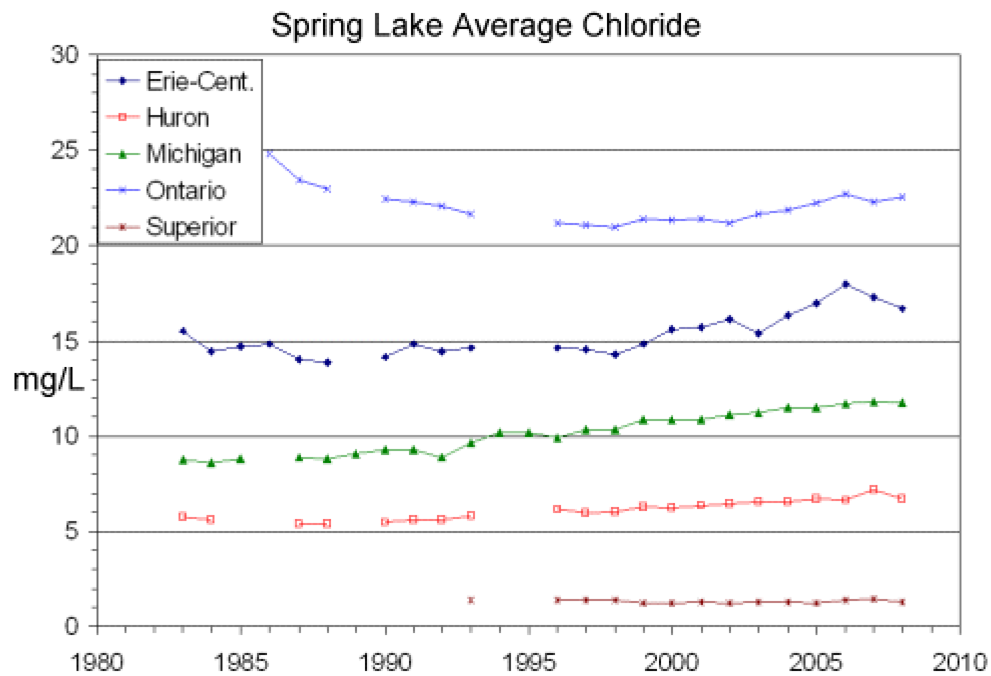

Figure 1: Chloride trends in the Great Lakes from 1983 to 2008

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B Pollutant Metals Analysis

Copper

New York Gateway
Attachment C - Concentration Calculations for Pollutant Loadings and Impacts from Highway Storm Water Runoff
Calculations for Once-in-Three-Year Stream Pollutant Concentrations
(No Build Condition)

Worksheet A

Site Characteristics

1 Drainage Area of Highway Segment

a	Total right of way	(acres)	AROW	7.15
b	Paved Surface	(acres)	AHWY	6.12
c	Percent Impervious (=100*AHWY/AROW)		IMP	85.6

2. Rainfall Characteristics

			MEAN	
a	Volume	(inch)	MVP	0.26
b	Intensity	(inch/hour)	MIP	0.051
c	Duration	(hour)	MDP	5.8
d	Interval	(hour)	MTP	73

			COEF of VARIATION	
e	Volume	(dimensionless)	CVVP	1.46
f	Intensity	(dimensionless)	CVIP	1.31
g	Duration	(dimensionless)	CVDP	1.05
h	Interval	(dimensionless)	CVTP	1.07

I	Number of storms per year (24*365/MTP)	NST	120

3. Surrounding Area Type

a	ADT usually over 30,000 vehicles/day	URBAN	YES
	or		
b	ADT usually under 30,000 vpd, undeveloped or suburban	RURAL	NO

4. Select pollutant for analysis and estimate runoff quality characteristics

				Copper
a	Site median concentration	(mg/l)	TCR	0.054
b	coef of variation (0.71 urban; 0.84 Rural)		CVCR	0.71

5. Select receiving water target concentration

surface water Total Hardness	(mg/l)	TH	150

STREAM

a	EPA Acute Criterion	(mg/l)	CTA	0.026
b	Suggested Threshold Effect Level	(mg/l)	CTT	0.06

6.Watershed Drainage Area (square miles) — ATOT 22,720

upstream of highway for a stream - total contributing area for a lake

7. Average annual stream flow

a	Unit area flow rate (CFS) per square mile		QSM	1.6
b	Coef of variation of stream flows		CVQS	1.5
c	Average stream flow (QSM*ATOT)	(CFS)	MQS	36,352

Copper

(No Build Condition)

Worksheet B

Highway Runoff Characteristics

1. Compute runoff coefficient (Rv)

a	Percent Imperious (Worksheet A - Item 1c)	IMP	85.59
b	Runoff Coefficient (=0.007*IMP+0.1)	Rv	0.699

2. Compute runoff flow rates

a	Flow Rate from mean storm (CFS)		
	=Rv*MIP*AROW	MQR	0.25
b	Coefficent of variation of runoff volumes		
	=CVIP (Worksheet A - Item 2f)	CVQR	1.31

3. Compute runoff volume

a	Volume from the mean storm (CF)		
	=Rv*MVP*AROW*3630	MVR	4,718
b	Coefficient of variation of runoff volumes		
	=CVVP (Worksheet A - Item 2e)	CVVP	1.46

4. Compute Mass

	Site Median Concentration (Worksheet A - Item 4a)	TCR	0.054
	Coef of var. of site EMC's (Worksheet A - 4b)	CVCR	0.71
	Number of storms per year (Worksheet a - 2i)	NST	120

a	mean event concentration (MCR) (mg/l)		
	= TCR*SQRT(1+CVCR^2)	MCR	0.066
b	mean event mass load (pounds)		
	= MCR*MVR*(0.00006245)	M(MASS)	0.02
c	annual mass load from runoff (pounds/yr)		
	=M(MASS)*NST	ANMASS	2.34

5. Compute flow ratio (MQS/MQR)

a	ratio of average stream flow (Worksheet A -7b)		
	to MQR	MQS/MQR	142,585

Copper

(No Build Condition)

Worksheet C

Stream Impact Analysis

1. Define the flow ratio MQS/MQR (Worksheet B-5a) MQS/MQR 142,585

2. Compute the event frequency for a 3 year recurrence interval

a	Enter the average number of storms per year			
	(from Worksheet A - item 2i)		NST	120
b	Compute the probability (%) of the three-year event			
	=100*(1/(NST*3))		PR	0.28

3.Enter value from table 7

	for MQS/MQR and frequencey PR	(mg/l)	CU	0.0059

4. Select pollutant for analysis **Copper**

a	Site median concentration	(mg/l)	TCR	0.054
b	Solube fraction		FSOL	0.4
	(Copper: 40%; Lead: 10%; Zinc: 40%)			
c	Acute Criteria Value	(mg/l)	CTA	0.026
d	Threshold effects level	(mg/l)	CTT	0.06

5. Compute the once in 3 year stream pollutant concentration

	=CU*TCR*FSOL	(mg/l)	CO	0.0001

6. Compare with target concentration, CTA

	=CO/CTA	CRAT	0.005

7.Evalute results

a	If CRAT is less than about 0.75		**STOP**
	A toxicity problem attributable to this pollutant is unlikely		
b	If CRAT is greater than 5 reduction will definitely be required		
	Estimate the level of reduction possible and repeat the analysis with		
	revised value for either concentration or flow or both		
c	If CRAT is still greater than 1 and greater reduction levles are not practical…		
	Estimate the potential for an adverse impact (as opposed to a criteria		
	violation) by a comparison with the threshold effects level		
	=CO/CTT	**CRTE**	0.00

Copper

New York Gateway

Attachment C - Concentration Calculations for Pollutant Loadings and Impacts from Highway Storm Water Runoff

Calculations for Once-in-Three-Year Stream Pollutant Concentrations

(Build Condition)

Worksheet A

Site Characteristics

1 Drainage Area of Highway Segment

a	Total right of way	(acres)	AROW	7.15
b	Paved Surface	(acres)	AHWY	5.84
c	Percent Impervious (=100*AHWY/AROW)		IMP	81.7

2. Rainfall Characteristics

			MEAN	
a	Volume	(inch)	MVP	0.26
b	Intensity	(inch/hour)	MIP	0.051
c	Duration	(hour)	MDP	5.8
d	Interval	(hour)	MTP	73

			COEF of VARIATION	
e	Volume	(dimensionless)	CVVP	1.46
f	Intensity	(dimensionless)	CVIP	1.31
g	Duration	(dimensionless)	CVDP	1.05
h	Interval	(dimensionless)	CVTP	1.07

I	Number of storms per year (24*365/MTP)	NST	120

3. Surrounding Area Type

a	ADT usually over 30,000 vehicles/day	URBAN	YES
	or		
b	ADT usually under 30,000 vpd, undeveloped or suburban	RURAL	NO

4. Select pollutant for analysis and estimate runoff quality characteristics

				Copper
a	Site median concentration	(mg/l)	TCR	0.054
b	coef of variation (0.71 urban; 0.84 Rural)		CVCR	0.71

5. Select receiving water target concentration

surface water Total Hardness	(mg/l)	TH	150

STREAM

a	EPA Acute Criterion	(mg/l)	CTA	0.026
b	Suggested Threshold Effect Level	(mg/l)	CTT	0.06

6.Watershed Drainage Area (square miles) ATOT 22,720

upstream of highway for a stream - total contributing area for a lake

7. Average annual stream flow

a	Unit area flow rate (CFS) per square mile		QSM	1.6
b	Coef of variation of stream flows		CVQS	1.5
c	Average stream flow (QSM*ATOT)	(CFS)	MQS	36,352

Copper

(Build Condition)

Worksheet B

Highway Runoff Characteristics

1. Compute runoff coefficient (Rv)

a	Percent Imperious (Worksheet A - Item 1c)	IMP	81.68
b	Runoff Coefficient (=0.007*IMP+0.1)	Rv	0.672

2. Compute runoff flow rates

a	Flow Rate from mean storm	(CFS)		
	=Rv*MIP*AROW		MQR	0.24
b	Coefficent of variation of runoff volumes			
	=CVIP (Worksheet A - Item 2f)		CVQR	1.31

3. Compute runoff volume

a	Volume from the mean storm	(CF)		
	=Rv*MVP*AROW*3630		MVR	4,533
b	Coefficient of variation of runoff volumes			
	=CVVP (Worksheet A - Item 2e)		CVVP	1.46

4. Compute Mass

	Site Median Concentration (Worksheet A - Item 4a)	TCR	0.054
	Coef of var. of site EMC's (Worksheet A - 4b)	CVCR	0.71
	Number of storms per year (Worksheet a - 2i)	NST	120

a	mean event concentration (MCR) (mg/l)			
	= TCR*SQRT(1+CVCR^2)		MCR	0.066
b	mean event mass load	(pounds)		
	= MCR*MVR*(0.00006245)		M(MASS)	0.02
c	annual mass load from runoff	(pounds/yr)		
	=M(MASS)*NST		ANMASS	2.25

5. Compute flow ratio (MQS/MQR)

a	ratio of average stream flow (Worksheet A -7b)		
	to MQR	MQS/MQR	148,404

Copper

(Build Condition)

Worksheet C

Stream Impact Analysis

1. Define the flow ratio MQS/MQR (Worksheet B-5a) MQS/MQR 148,404

2. Compute the event frequency for a 3 year recurrence interval

a	Enter the average number of storms per year			
	(from Worksheet A - item 2i)		NST	120
b	Compute the probability (%) of the three-year event			
	=100*(1/(NST*3))		PR	0.28

3.Enter value from table 7

	for MQS/MQR and frequencey PR	(mg/l)	CU	0.0058

4. Select pollutant for analysis **Copper**

a	Site median concentration	(mg/l)	TCR	0.054
b	Solube fraction		FSOL	0.4
	(Copper: 40%; Lead: 10%; Zinc: 40%)			
c	Acute Criteria Value	(mg/l)	CTA	0.026
d	Threshold effects level	(mg/l)	CTT	0.06

5. Compute the once in 3 year stream pollutant concentration

	=CU*TCR*FSOL	(mg/l)	CO	0.0001

6. Compare with target concentration, CTA

	=CO/CTA	CRAT	0.005

7.Evalute results

a	If CRAT is less than about 0.75		**STOP**
	A toxicity problem attributable to this pollutant is unlikely		
b	If CRAT is greater than 5 reduction will definitely be required		
	Estimate the level of reduction possible and repeat the analysis with		
	revised value for either concentration or flow or both		
c	If CRAT is still greater than 1 and greater reduction levles are not practical…		
	Estimate the potential for an adverse impact (as opposed to a criteria		
	violation) by a comparison with the threshold effects level		
	=CO/CTT	**CRTE**	0.00

Lead

New York Gateway

Attachment C - Concentration Calculations for Pollutant Loadings and Impacts from Highway Storm Water Runoff

Calculations for Once-in-Three-Year Stream Pollutant Concentrations

(No Build Condition)

Worksheet A

Site Characteristics

1 Drainage Area of Highway Segment

a	Total right of way	(acres)	AROW	7.15
b	Paved Surface	(acres)	AHWY	6.12
c	Percent Impervious (=100*AHWY/AROW)		IMP	85.6

2. Rainfall Characteristics

			MEAN	
a	Volume	(inch)	MVP	0.26
b	Intensity	(inch/hour)	MIP	0.051
c	Duration	(hour)	MDP	5.8
d	Interval	(hour)	MTP	73

			COEF of VARIATION	
e	Volume	(dimensionless)	CVVP	1.46
f	Intensity	(dimensionless)	CVIP	1.31
g	Duration	(dimensionless)	CVDP	1.05
h	Interval	(dimensionless)	CVTP	1.07

I	Number of storms per year (24*365/MTP)	NST	120

3. Surrounding Area Type

a	ADT usually over 30,000 vehicles/day	URBAN	YES
	or		
b	ADT usually under 30,000 vpd, undeveloped or suburban	RURAL	NO

4. Select pollutant for analysis and estimate runoff quality characteristics

				Lead
a	Site median concentration	(mg/l)	TCR	0.4
b	coef of variation (0.71 urban; 0.84 Rural)		CVCR	0.71

5. Select receiving water target concentration

surface water Total Hardness	(mg/l)	TH	150

STREAM

a	EPA Acute Criterion	(mg/l)	CTA	0.137
b	Suggested Threshold Effect Level	(mg/l)	CTT	0.6

6.Watershed Drainage Area (square miles) ATOT 22,720

upstream of highway for a stream - total contributing area for a lake

7. Average annual stream flow

a	Unit area flow rate (CFS) per square mile		QSM	1.6
b	Coef of variation of stream flows		CVQS	1.5
c	Average stream flow (QSM*ATOT)	(CFS)	MQS	36,352

Lead

(No Build Condition)

Worksheet B

Highway Runoff Characteristics

1. Compute runoff coefficient (Rv)

a	Percent Imperious (Worksheet A - Item 1c)	IMP	85.59
b	Runoff Coefficient (=0.007*IMP+0.1)	Rv	0.699

2. Compute runoff flow rates

a	Flow Rate from mean storm (CFS)		
	=Rv*MIP*AROW	MQR	0.25
b	Coefficent of variation of runoff volumes		
	=CVIP (Worksheet A - Item 2f)	CVQR	1.31

3. Compute runoff volume

a	Volume from the mean storm (CF)		
	=Rv*MVP*AROW*3630	MVR	4,718
b	Coefficient of variation of runoff volumes		
	=CVVP (Worksheet A - Item 2e)	CVVP	1.46

4. Compute Mass

	Site Median Concentration (Worksheet A - Item 4a)	TCR	0.4
	Coef of var. of site EMC's (Worksheet A - 4b)	CVCR	0.71
	Number of storms per year (Worksheet a - 2i)	NST	120

a	mean event concentration (MCR) (mg/l)		
	= TCR*SQRT(1+CVCR^2)	MCR	0.491
b	mean event mass load (pounds)		
	= MCR*MVR*(0.00006245)	M(MASS)	0.14
c	annual mass load from runoff (pounds/yr)		
	=M(MASS)*NST	ANMASS	17.35

5. Compute flow ratio (MQS/MQR)

a	ratio of average stream flow (Worksheet A -7b)		
	to MQR	MQS/MQR	142,585

Lead

(No Build Condition)

Worksheet C

Stream Impact Analysis

1. Define the flow ratio MQS/MQR (Worksheet B-5a)			MQS/MQR	142,585

2. Compute the event frequency for a 3 year recurrence interval

a	Enter the average number of storms per year			
	(from Worksheet A - item 2i)		NST	120
b	Compute the probability (%) of the three-year event			
	=100*(1/(NST*3))		PR	0.28

3.Enter value from table 7

for MQS/MQR and frequencey PR	(mg/l)	CU	0.0059

4. Select pollutant for analysis **Lead**

a	Site median concentration	(mg/l)	TCR	0.4
b	Solube fraction		FSOL	0.1
	(Copper: 40%; Lead: 10%; Zinc: 40%)			
c	Acute Criteria Value	(mg/l)	CTA	0.137
d	Threshold effects level	(mg/l)	CTT	0.6

5. Compute the once in 3 year stream pollutant concentration

=CU*TCR*FSOL	(mg/l)	CO	0.0002

6. Compare with target concentration, CTA

=CO/CTA	CRAT	0.002

7.Evalute results

a	If CRAT is less than about 0.75		**STOP**
	A toxicity problem attributable to this pollutant is unlikely		
b	If CRAT is greater than 5 reduction will definitely be required		
	Estimate the level of reduction possible and repeat the analysis with		
	revised value for either concentration or flow or both		
c	If CRAT is still greater than 1 and greater reduction levles are not practical…		
	Estimate the potential for an adverse impact (as opposed to a criteria		
	violation) by a comparison with the threshold effects level		
	=CO/CTT	**CRTE**	0.00

Lead

New York Gateway

Attachment C - Concentration Calculations for Pollutant Loadings and Impacts from Highway Storm Water Runoff

Calculations for Once-in-Three-Year Stream Pollutant Concentrations

(Build Condition)

Worksheet A

Site Characteristics

1 Drainage Area of Highway Segment

a	Total right of way	(acres)	AROW	7.15
b	Paved Surface	(acres)	AHWY	5.84
c	Percent Impervious (=100*AHWY/AROW)		IMP	81.7

2. Rainfall Characteristics — **MEAN**

a	Volume	(inch)	MVP	0.26
b	Intensity	(inch/hour)	MIP	0.051
c	Duration	(hour)	MDP	5.8
d	Interval	(hour)	MTP	73

COEF of VARIATION

e	Volume	(dimensionless)	CVVP	1.46
f	Intensity	(dimensionless)	CVIP	1.31
g	Duration	(dimensionless)	CVDP	1.05
h	Interval	(dimensionless)	CVTP	1.07

I	Number of storms per year (24*365/MTP)	NST	120

3. Surrounding Area Type

a	ADT usually over 30,000 vehicles/day	URBAN	YES
	or		
b	ADT usually under 30,000 vpd, undeveloped or suburban	RURAL	NO

4. Select pollutant for analysis and estimate runoff quality characteristics — **Lead**

a	Site median concentration	(mg/l)	TCR	0.4
b	coef of variation (0.71 urban; 0.84 Rural)		CVCR	0.71

5. Select receiving water target concentration

surface water Total Hardness	(mg/l)	TH	150

STREAM

a	EPA Acute Criterion	(mg/l)	CTA	0.137
b	Suggested Threshold Effect Level	(mg/l)	CTT	0.6

6.Watershed Drainage Area (square miles) — ATOT 22,720

upstream of highway for a stream - total contributing area for a lake

7. Average annual stream flow

a	Unit area flow rate (CFS) per square mile		QSM	1.6
b	Coef of variation of stream flows		CVQS	1.5
c	Average stream flow (QSM*ATOT)	(CFS)	MQS	36,352

Lead

(Build Condition)

Worksheet B

Highway Runoff Characteristics

1. Compute runoff coefficient (Rv)

a	Percent Imperious (Worksheet A - Item 1c)	IMP	81.68
b	Runoff Coefficient (=0.007*IMP+0.1)	Rv	0.672

2. Compute runoff flow rates

a	Flow Rate from mean storm (CFS)		
	=Rv*MIP*AROW	MQR	0.24
b	Coefficent of variation of runoff volumes		
	=CVIP (Worksheet A - Item 2f)	CVQR	1.31

3. Compute runoff volume

a	Volume from the mean storm (CF)		
	=Rv*MVP*AROW*3630	MVR	4,533
b	Coefficient of variation of runoff volumes		
	=CVVP (Worksheet A - Item 2e)	CVVP	1.46

4. Compute Mass

	Site Median Concentration (Worksheet A - Item 4a)	TCR	0.4
	Coef of var. of site EMC's (Worksheet A - 4b)	CVCR	0.71
	Number of storms per year (Worksheet a - 2i)	NST	120

a	mean event concentration (MCR) (mg/l)		
	= TCR*SQRT(1+CVCR^2)	MCR	0.491
b	mean event mass load (pounds)		
	= MCR*MVR*(0.00006245)	M(MASS)	0.14
c	annual mass load from runoff (pounds/yr)		
	=M(MASS)*NST	ANMASS	16.66

5. Compute flow ratio (MQS/MQR)

a	ratio of average stream flow (Worksheet A -7b)		
	to MQR	MQS/MQR	148,404

Lead

(Build Condition)

Worksheet C

Stream Impact Analysis

1. Define the flow ratio MQS/MQR (Worksheet B-5a) MQS/MQR 148,404

2. Compute the event frequency for a 3 year recurrence interval

a	Enter the average number of storms per year			
	(from Worksheet A - item 2i)		NST	120
b	Compute the probability (%) of the three-year event			
	=100*(1/(NST*3))		PR	0.28

3.Enter value from table 7

	for MQS/MQR and frequencey PR	(mg/l)	CU	0.0058

4. Select pollutant for analysis **Lead**

a	Site median concentration	(mg/l)	TCR	0.4
b	Solube fraction		FSOL	0.1
	(Copper: 40%; Lead: 10%; Zinc: 40%)			
c	Acute Criteria Value	(mg/l)	CTA	0.137
d	Threshold effects level	(mg/l)	CTT	0.6

5. Compute the once in 3 year stream pollutant concentration

	=CU*TCR*FSOL	(mg/l)	CO	0.0002

6. Compare with target concentration, CTA

	=CO/CTA		CRAT	0.002

7.Evalute results

a	If CRAT is less than about 0.75		**STOP**
	A toxicity problem attributable to this pollutant is unlikely		
b	If CRAT is greater than 5 reduction will definitely be required		
	Estimate the level of reduction possible and repeat the analysis with		
	revised value for either concentration or flow or both		
c	If CRAT is still greater than 1 and greater reduction levles are not practical…		
	Estimate the potential for an adverse impact (as opposed to a criteria		
	violation) by a comparison with the threshold effects level		
	=CO/CTT	**CRTE**	0.00

Zinc

New York Gateway

Attachment C - Concentration Calculations for Pollutant Loadings and Impacts from Highway Storm Water Runoff

Calculations for Once-in-Three-Year Stream Pollutant Concentrations

(No Build Condition)

Worksheet A

Site Characteristics

1 Drainage Area of Highway Segment

a	Total right of way	(acres)	AROW	7.15
b	Paved Surface	(acres)	AHWY	6.12
c	Percent Impervious (=100*AHWY/AROW)		IMP	85.6

2. Rainfall Characteristics

			MEAN	
a	Volume	(inch)	MVP	0.26
b	Intensity	(inch/hour)	MIP	0.051
c	Duration	(hour)	MDP	5.8
d	Interval	(hour)	MTP	73

			COEF of VARIATION	
e	Volume	(dimensionless)	CVVP	1.46
f	Intensity	(dimensionless)	CVIP	1.31
g	Duration	(dimensionless)	CVDP	1.05
h	Interval	(dimensionless)	CVTP	1.07

I	Number of storms per year (24*365/MTP)	NST	120

3. Surrounding Area Type

a	ADT usually over 30,000 vehicles/day	URBAN	YES
	or		
b	ADT usually under 30,000 vpd, undeveloped or suburban	RURAL	NO

4. Select pollutant for analysis and estimate runoff quality characteristics

				Zinc
a	Site median concentration	(mg/l)	TCR	0.329
b	coef of variation (0.71 urban; 0.84 Rural)		CVCR	0.71

5. Select receiving water target concentration

surface water Total Hardness	(mg/l)	TH	150

STREAM

a	EPA Acute Criterion	(mg/l)	CTA	0.45
b	Suggested Threshold Effect Level	(mg/l)	CTT	0.945

6.Watershed Drainage Area (square miles) — ATOT 22,720

upstream of highway for a stream - total contributing area for a lake

7. Average annual stream flow

a	Unit area flow rate (CFS) per square mile		QSM	1.6
b	Coef of variation of stream flows		CVQS	1.5
c	Average stream flow (QSM*ATOT)	(CFS)	MQS	36,352

Zinc

(No Build Condition)

Worksheet B

Highway Runoff Characteristics

1. Compute runoff coefficient (Rv)

a	Percent Imperious (Worksheet A - Item 1c)	IMP	85.59
b	Runoff Coefficient (=0.007*IMP+0.1)	Rv	0.699

2. Compute runoff flow rates

a	Flow Rate from mean storm	(CFS)		
	=Rv*MIP*AROW		MQR	0.25
b	Coefficent of variation of runoff volumes			
	=CVIP (Worksheet A - Item 2f)		CVQR	1.31

3. Compute runoff volume

a	Volume from the mean storm	(CF)		
	=Rv*MVP*AROW*3630		MVR	4,718
b	Coefficient of variation of runoff volumes			
	=CVVP (Worksheet A - Item 2e)		CVVP	1.46

4. Compute Mass

	Site Median Concentration (Worksheet A - Item 4a)	TCR	0.329
	Coef of var. of site EMC's (Worksheet A - 4b)	CVCR	0.71
	Number of storms per year (Worksheet a - 2i)	NST	120

a	mean event concentration (MCR) (mg/l)			
	= TCR*SQRT(1+CVCR^2)		MCR	0.403
b	mean event mass load	(pounds)		
	= MCR*MVR*(0.00006245)		M(MASS)	0.12
c	annual mass load from runoff	(pounds/yr)		
	=M(MASS)*NST		ANMASS	14.27

5. Compute flow ratio (MQS/MQR)

a	ratio of average stream flow (Worksheet A -7b)		
	to MQR	MQS/MQR	142,585

Zinc

(No Build Condition)

Worksheet C

Stream Impact Analysis

1. Define the flow ratio MQS/MQR (Worksheet B-5a) MQS/MQR 142,585

2. Compute the event frequency for a 3 year recurrence interval

a	Enter the average number of storms per year			
	(from Worksheet A - item 2i)		NST	120
b	Compute the probability (%) of the three-year event			
	=100*(1/(NST*3))		PR	0.28

3.Enter value from table 7

	for MQS/MQR and frequencey PR	(mg/l)	CU	0.0059

4. Select pollutant for analysis **Zinc**

a	Site median concentration	(mg/l)	TCR	0.329
b	Solube fraction		FSOL	0.4
	(Copper: 40%; Lead: 10%; Zinc: 40%)			
c	Acute Criteria Value	(mg/l)	CTA	0.45
d	Threshold effects level	(mg/l)	CTT	0.945

5. Compute the once in 3 year stream pollutant concentration

	=CU*TCR*FSOL	(mg/l)	CO	0.0008

6. Compare with target concentration, CTA

	=CO/CTA		CRAT	0.002

7.Evalute results

a	If CRAT is less than about 0.75		**STOP**
	A toxicity problem attributable to this pollutant is unlikely		
b	If CRAT is greater than 5 reduction will definitely be required		
	Estimate the level of reduction possible and repeat the analysis with		
	revised value for either concentration or flow or both		
c	If CRAT is still greater than 1 and greater reduction levles are not practical…		
	Estimate the potential for an adverse impact (as opposed to a criteria		
	violation) by a comparison with the threshold effects level		
	=CO/CTT	**CRTE**	0.00

Zinc

New York Gateway
Attachment C - Concentration Calculations for Pollutant Loadings and Impacts from Highway Storm Water Runoff
Calculations for Once-in-Three-Year Stream Pollutant Concentrations
(Build Condition)

Worksheet A

Site Characteristics

1 Drainage Area of Highway Segment

a	Total right of way	(acres)	AROW	7.15
b	Paved Surface	(acres)	AHWY	5.84
c	Percent Impervious (=100*AHWY/AROW)		IMP	81.7

2. Rainfall Characteristics **MEAN**

a	Volume	(inch)	MVP	0.26
b	Intensity	(inch/hour)	MIP	0.051
c	Duration	(hour)	MDP	5.8
d	Interval	(hour)	MTP	73

COEF of VARIATION

e	Volume	(dimensionless)	CVVP	1.46
f	Intensity	(dimensionless)	CVIP	1.31
g	Duration	(dimensionless)	CVDP	1.05
h	Interval	(dimensionless)	CVTP	1.07

I	Number of storms per year (24*365/MTP)	NST	120

3. Surrounding Area Type

a	ADT usually over 30,000 vehicles/day	URBAN	YES
	or		
b	ADT usually under 30,000 vpd, undeveloped or suburban	RURAL	NO

4. Select pollutant for analysis and estimate runoff quality characteristics **Zinc**

a	Site median concentration	(mg/l)	TCR	0.329
b	coef of variation (0.71 urban; 0.84 Rural)		CVCR	0.71

5. Select receiving water target concentration

surface water Total Hardness	(mg/l)	TH	150

STREAM

a	EPA Acute Criterion	(mg/l)	CTA	0.45
b	Suggested Threshold Effect Level	(mg/l)	CTT	0.945

6.Watershed Drainage Area (square miles) ATOT 22,720
upstream of highway for a stream - total contributing area for a lake

7. Average annual stream flow

a	Unit area flow rate (CFS) per square mile		QSM	1.6
b	Coef of variation of stream flows		CVQS	1.5
c	Average stream flow (QSM*ATOT)	(CFS)	MQS	36,352

Zinc

(Build Condition)

Worksheet B

Highway Runoff Characteristics

1. Compute runoff coefficient (Rv)

a	Percent Imperious (Worksheet A - Item 1c)	IMP	81.68
b	Runoff Coefficient (=0.007*IMP+0.1)	Rv	0.672

2. Compute runoff flow rates

a	Flow Rate from mean storm	(CFS)		
	=Rv*MIP*AROW		MQR	0.24
b	Coefficent of variation of runoff volumes			
	=CVIP (Worksheet A - Item 2f)		CVQR	1.31

3. Compute runoff volume

a	Volume from the mean storm	(CF)		
	=Rv*MVP*AROW*3630		MVR	4,533
b	Coefficient of variation of runoff volumes			
	=CVVP (Worksheet A - Item 2e)		CVVP	1.46

4. Compute Mass

	Site Median Concentration (Worksheet A - Item 4a)	TCR	0.329
	Coef of var. of site EMC's (Worksheet A - 4b)	CVCR	0.71
	Number of storms per year (Worksheet a - 2i)	NST	120

a	mean event concentration (MCR) (mg/l)			
	= TCR*SQRT(1+CVCR^2)		MCR	0.403
b	mean event mass load	(pounds)		
	= MCR*MVR*(0.00006245)		M(MASS)	0.11
c	annual mass load from runoff	(pounds/yr)		
	=M(MASS)*NST		ANMASS	13.71

5. Compute flow ratio (MQS/MQR)

a	ratio of average stream flow (Worksheet A -7b)		
	to MQR	MQS/MQR	148,404

Zinc

(Build Condition)

Worksheet C

Stream Impact Analysis

1. Define the flow ratio MQS/MQR (Worksheet B-5a) MQS/MQR 148,404

2. Compute the event frequency for a 3 year recurrence interval

a	Enter the average number of storms per year			
	(from Worksheet A - item 2i)		NST	120
b	Compute the probability (%) of the three-year event			
	=100*(1/(NST*3))		PR	0.28

3.Enter value from table 7

for MQS/MQR and frequencey PR	(mg/l)	CU	0.0058

4. Select pollutant for analysis **Zinc**

a	Site median concentration	(mg/l)	TCR	0.329
b	Solube fraction		FSOL	0.4
	(Copper: 40%; Lead: 10%; Zinc: 40%)			
c	Acute Criteria Value	(mg/l)	CTA	0.45
d	Threshold effects level	(mg/l)	CTT	0.945

5. Compute the once in 3 year stream pollutant concentration

=CU*TCR*FSOL	(mg/l)	CO	0.0008

6. Compare with target concentration, CTA

=CO/CTA	CRAT	0.002

7.Evalute results

a	If CRAT is less than about 0.75		**STOP**
	A toxicity problem attributable to this pollutant is unlikely		
b	If CRAT is greater than 5 reduction will definitely be required		
	Estimate the level of reduction possible and repeat the analysis with		
	revised value for either concentration or flow or both		
c	If CRAT is still greater than 1 and greater reduction levles are not practical…		
	Estimate the potential for an adverse impact (as opposed to a criteria		
	violation) by a comparison with the threshold effects level		
	=CO/CTT	**CRTE**	0.00